AGRICULTURAL Research

U.S. DEPARTMENT OF AGRICULTURE

NOVEMBER 1970

"S"

AGRICULTURAL
Research

November 1970/Vol. 19, No. 5

Treasure Trees

An ancient agricultural industry—the production of naval stores—thrives across the forests of the South. There men still wrest from pine trees products that in earlier times were used to caulk the seams of wooden ships and to preserve their tackle and sails. Today the pines provide a rich store of raw materials for articles far removed from the world of ships.

Steeped in history, this picturesque industry is mentioned in some of man's earliest writings, including the Genesis account of the making of the ark wherein Noah was commanded to cover it "within and without with pitch." Like the maritime peoples of the Mediterranean, settlers in the New World collected gum—also called oleoresin—by cutting streaklike wounds into living pine trees. Gum oozing from the wounds trickled into attached receptacles, then was gathered, poured into pots, and heated until a pitchy mass remained. For a time pitch and tar came from the pitch pines of New England and Virginia, but soon the industry moved to the South to tap its higher yielding slash and longleaf pines. For many years primitive methods of collecting and distilling gum prevailed.

The industry has changed greatly, especially since 1932 when research findings began to come from ARS' Naval Stores Laboratory at Olustee, Fla. Tiny and inefficient wood-fired stills which once dotted the pinelands gave way to large, modern, centrally located plants employing the "Olustee process." Product quality improved markedly.

Once processing methods were modernized, the lab's scientists concentrated on developing new and improved products from an increasing number of naval stores derivatives. Primary naval stores of modern times, incidentally, include turpentine and rosin obtained not only from gum but also from stumps of pine trees and from the conversion of pine wood into paper by the sulphate pulping process. ARS scientists have helped find uses for naval stores in such products as cleaning agents, perfumes, sizing for paper, adhesives, and plastics for car bodies. Some derivatives may prove useful in making antihistamine and anticoagulant for human medicine.

Small amounts of these unusual agricultural products still find their way into food, clothing, and shelter. But their importance will grow in an ever widening array of products seemingly unrelated to agriculture.

***Editor:** R. P. Kaniuka*
***Managing Editor:** E. H. Davis*

Contributors to this issue:
R. C. Bjork, J. P. Dean,
V. M. Dryden, A. J. Feeney,
C. E. Herron, L. W. Lindemer,
D. H. Mayberry, M. M. Memolo,
D. M. Webb

Cover: Adult male gypsy moth is held captive in a holding device. As lure components are separated, moths are exposed to the scent and their response is recorded (0770C680-13).

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), United States Department of Agriculture, Washington, D.C. 20250. Printing has been approved by the Bureau of the Budget, June 1967. Yearly subscription rate is $1.50 in the United States and countries of the Postal Union, $2.00 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Use of commercial names and brands is for identification only and does not imply endorsement or approval by USDA or ARS. Information in this periodical is public property and may be reprinted without permission. Mention of the source will be appreciated but is not required.

Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service

Checkout by computer

A REVOLUTIONARY COMPUTERIZED SYSTEM to speed up supermarket checkouts promises greater efficiency and economy for both consumers and the food trade industry.

For instance: The system will eliminate ring-up error, insure accurate pricing, and provide customers with itemized and detailed records of purchasing. For the food industry, it will cut labor and management costs by eliminating individual marking and changing of prices, automating the ordering of shelf replacements, and providing a continuous inventory.

The improved checkout system and its performance specifications were conceived about 5 years ago by ARS transportation and facilities specialists at Hyattsville, Md. A prototype system meeting these specifications has been developed by one of several commercial firms that showed interest in the concept.

Basically, four pieces of equipment are linked to form the computerized checkout system—a tabulator, a teletype, a computer, and the key

component—an electronic scanner that "reads" coded labels on the grocery items.

The code label, a small round disk affixed by the food manufacturers, can record 100 million characters to identify the specific size, brand, and weight of grocery products.

At the checkout counter, the cashier gently touches the scanner to the code label on each item of a grocery order. The scanner reads the code and sends the information to the computer, which identifies the product and its current price. Then the name of the product together with its total price and unit price is relayed to the tabulator, and the information is printed on the receipt tape.

At the same time, the price of each item as it is checked through is displayed visually on the tabulator. The computer automatically adjusts charges for special sale items that sell for less per package when more than one is purchased, for example, spaghetti selling for 35 cents each or 3 for $1. Regardless of where in the order they appear, the computer would charge 35 cents for the first two packages, then only 30 cents for the third package when it is checked through. All special sale items are identified on the receipt tape with a star.

When the entire order has been checked out, the customer receives a tape itemizing each purchase by name along with package price and unit price. In addition, at the bottom of the tape the total cost of the order is shown together with any tax, number of stamps due if they're used, any credits for "cents off" coupons, and the adjusted total.

Coupons would have the code included when the coupons are printed, and the computers would be programed to identify their worth. The computer would remember all items in the order and credit only those coupons for which an actual purchase has been made.

Though the code numbers would be meaningless to consumers, prices of products would be posted on the store shelves as they are now. Also, scanners with price read-out boards could be located at various places in the supermarket to enable price comparisons of different brands, and to verify package price against posted price.

The computerized system, while benefiting the consumer, holds even greater potential for the food trade by providing a broad spectrum of management information and service.

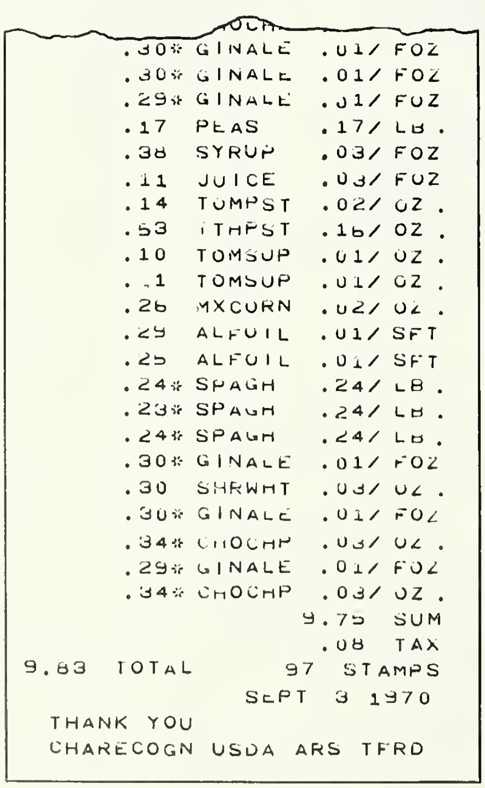
As groceries are checked out, the computer, which can service as many as 60 checkout counters simultaneously, maintains a continuous stock inventory. At any given moment—but usually at the close of the business day—the teletype can be activated to retrieve inventory data from the computer and print it out on a sheet. The sheet contains the name and code number of each product, the quantity on hand at the beginning of the day, the quantity sold, and the remaining stock balance.

In case of price changes, the computer simply is reprogramed to match a particular product with its new price, thus eliminating marking out of one price on a product and adding a new one. Similar efficiencies will be available at the warehouse.

Further, regional and national offices will be better able to monitor and predict merchandising trends.

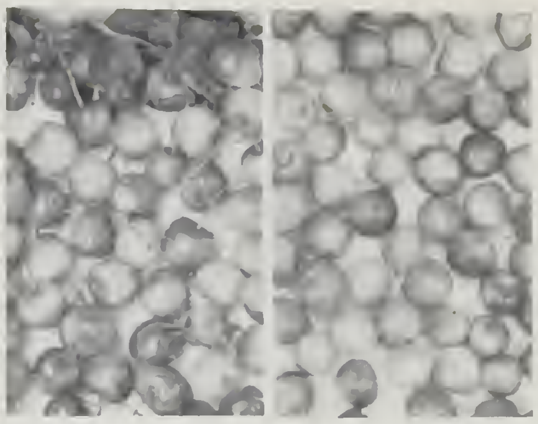
"Don't look for the system in your neighborhood supermarket tomorrow," say the researchers, "but now it's more than a dream. And we think it won't be long before computerized checkout counters throughout the Nation will be a reality." ▪

Right: On the code label, widths of the black bars establish the code. Numbers represented by the bars are also carried to permit visual product identification (BN–36748). ***Below left:*** *Grocery tape from the computer (PN–1907).* ***Below right:*** *Mrs. Sharon Flemming touches scanner to code label on each package. Scanner is being modified into a cylinder like a small flashlight for easier handling (770A615–5).*



.30*	GINALE	.01/	FOZ
.30*	GINALE	.01/	FOZ
.29*	GINALE	.01/	FOZ
.17	PEAS	.17/	LB .
.38	SYRUP	.03/	FOZ
.11	JUICE	.03/	FOZ
.14	TOMPST	.02/	OZ .
.53	THPST	.16/	OZ .
.10	TOMSUP	.01/	OZ .
.[illegible]1	TOMSUP	.01/	OZ .
.26	MXCORN	.02/	OZ .
.29	ALFOIL	.01/	SFT
.25	ALFOIL	.01/	SFT
.24*	SPAGH	.24/	LB .
.23*	SPAGH	.24/	LB .
.24*	SPAGH	.24/	LB .
.30*	GINALE	.01/	FOZ
.30	SHRWHT	.03/	OZ .
.30*	GINALE	.01/	FOZ
.34*	CHOCHP	.03/	OZ .
.29*	GINALE	.01/	FOZ
.34*	CHOCHP	.03/	OZ .
		9.75	SUM
		.08	TAX
9.83	TOTAL	97	STAMPS
		SEPT 3	1970

THANK YOU
CHARECOGN USDA ARS TFRD



Left: Treated sweet cherries are harvested mechanically (PN–1914). Above: The treated cherries at right had fewer stems, less trash, and fewer bruises (PN–1915, PN–1916).

CEPA aids sweet cherry harvest

A MAJOR OBSTACLE to mechanization of the sweet cherry harvest in Michigan and other Great Lake States may have been hurdled by the use of CEPA, an experimental chemical fruit loosener.

CEPA (2 - chloroethylphosphonic acid) promotes the normal separation of fruit from plants by aiding the development of a thin layer of pithy cells at the base of the stems. It supplies ethylene, a nontoxic ripening agent that occurs naturally in the tissues of most fruits.

Only about 25 percent of Michigan's sweet cherry crop is harvested mechanically. Moreover, only about 3 percent of the sweet cherries for brining—Michigan's principal outlet—are harvested by machine because of the difficulty in separating the cherries from the trees.

CEPA was tested during the 1969 harvest near Traverse City, Mich., by biochemist Robert T. Whittenberger and agricultural engineer Jordan H. Levin, both of ARS, pomologist Martin J. Bukovac of Michigan State Agricultural Experiment Station, and Bernard Zoss, an industry representative.

They found that spraying CEPA on Windsor and Emperor Francis trees 8 days before harvest greatly increased the recovery of fruit during harvest. At 500 parts per million (ppm) CEPA, fruit recovery was 92 percent with the Emperor Francis variety and 88 percent with the Windsor. Without CEPA treatment, recovery rates were 75 and 70 percent, respectively. A higher concentration, 1,000 ppm, did not significantly increase fruit recovery.

Allowing the chemical to act for 11 to 14 days before harvest resulted in recoveries of 96 and 98 percent, respectively.

The treatment speeded the overall harvesting operation by shortening the shaking period required for fruit removal. Also, the shorter shaking period resulted in less fruit damage and fewer leaves removed. Since CEPA did not loosen the leaves, the harvested fruit was relatively free of trash and attached stems. And CEPA did not cause any abnormal dropping of cherries before harvest.

Tests were run on brined, pitted, and maraschino cherries with results showing that:

- Cherries held in the brine for 74 days and graded by four processors were commercially acceptable, and in all cases the CEPA-treated lots were at least equal to untreated lots in quality and firmness. Treated lots tended to show less stem-end tearing than did the control lots.
- CEPA treatment in the orchard did not decrease yield of pitted fruit in the processing plant.
- No changes in procedures were required to accommodate the CEPA-treated fruit. No differences in grade attributable to CEPA treatment were observed, and all lots of the Emperor Francis variety and two-thirds of the Windsor lots rated good to excellent in quality.

At present, CEPA is being used on rubber trees as it promotes the oozing of the latex from the tree. Other possible uses for the chemical are in maple sugar and pineapple harvesting.

Price per acre of CEPA treatment of cherries runs under $20. ▪

1970 Atwater Memorial Lecture

'Can man shape his future?'

MAN'S DREAM for Earth's future—verdant fields, clear lakes and streams, abundant water, and the absence of disease—may be more than a dream.

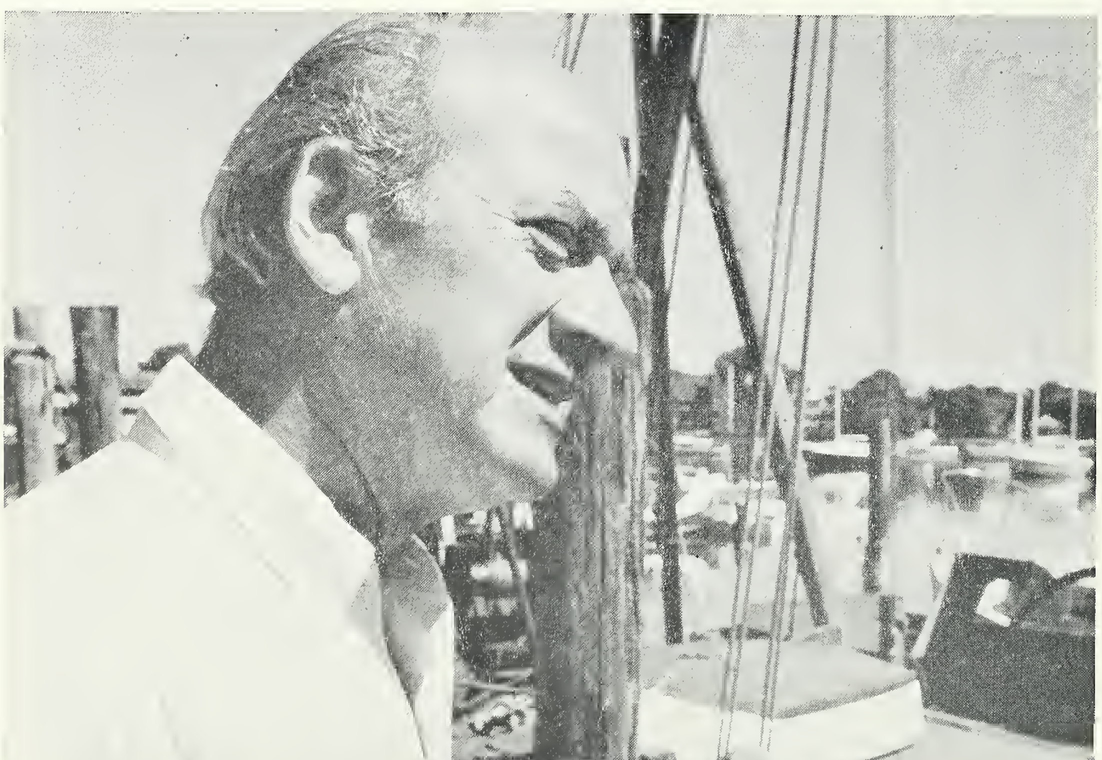
In this year's Atwater Memorial Lecture, Philip Handler, president of the National Academy of Sciences, says that science has provided the knowledge to make much of this dream possible, and "it will be fulfilled if mankind can survive the crises of this century."

The Atwater Memorial Lecture is sponsored by ARS to honor USDA's first chief of human nutrition research, Wilbur O. Atwater. "Can Man Shape His Future?" was the title of Dr. Handler's lecture. It was presented in Washington, D.C., during the weeklong convention of the Third International Congress of Food Science and Technology, which took SOS/70—Science of Survival/1970—as its signature.

"Biological and physical research can permit us to refashion ourselves and our world," Dr. Handler said. "If the dream fails, it will be because of the limitations of man the social creature, evidence for which is to be found daily on the front pages of our newspapers."

Despite the frenetic concern for environmental pollution, Dr. Handler added, there is really no question whether man can live with the technology he has developed.

Philip Handler (BN–36740).



"The real question is whether man can learn to live with himself. Just as ecology is too immature to cope with our vast environmental problems, the social sciences are too young to cope with our most pressing national and international problems. . . ."

Dr. Handler cited population control and conservation of the environment and our natural resources as the most pressing needs, along with establishing a stable permanent peace, achieving a successful and progressive "modus vivendi" in racial problems, coping with violence and crime, and abolishing world-wide poverty, illiteracy, and ignorance.

"It is not at all obvious that we have the understanding, or the social and political institutions to deal with these furious challenges—but seek them we must," Dr. Handler said. "Meanwhile, the long upward struggle of man from his animal origins affords cause for hope."

Dr. Handler is chairman of the National Research Council and has had a lifelong interest in nutrition. His earliest work as a scientist was concerned with protein deficiency and other problems of basic biochemistry related to nutritional disorders. From 1937 to 1939, Dr. Handler worked as a junior chemist for ARS at the U.S. Regional Soybean Laboratory, Urbana, Ill.

Dr. Handler's credentials include receiving his Ph. D. degree at the age of 21 from the University of Illinois, Urbana, coauthoring a widely-used textbook, "Principles of Biochemistry," and editing the recent report, "Biology and the Future of Man."

Previous Atwater Memorial Lecturers were Dr. Artturi I. Virtanen, Nobel Prize-winning Finnish chemist, and Dr. Albert Szent-Gyorgyi, Nobel Prize-winning biochemist. ■

Feeds from Crop wastes

A LABORATORY TECHNIQUE for measuring feed digestibility has indicated that high-pressure steam processing will convert rice straw and similar high-fiber wastes into digestible livestock feed.

These laboratory findings will be checked out in cooperative ARS-University of California studies by feeding treated waste to livestock.

Cellulose and hemicellulose in the cell walls of rice straw and similar tough, high-fiber material have long been recognized as potential sources of energy for ruminant animals such as cattle and sheep. But lignin, which is indigestible, is associated with the cellulosic materials in the cell wall structure, and the objective of processing is to modify this chemical structure to make the cellulosic part available.

Exploratory laboratory research on steam processing has been conducted by ARS scientists led by chemist George O. Kohler and chemical engineer Robert P. Graham at the Western utilization research laboratory, Albany, Calif.

In research conducted so far, the primary interest has been in rice and grass straws because they have become serious waste problems in some producing areas. A successful waste treatment, however, could have wider application—it is estimated that more than 200 million tons of straw and other lignified field-crop wastes are produced in the United States each year.

The ARS treatment basically consists of holding waste material under high-pressure steam (300 or 400 pounds) for 3 or 4 minutes. To prepare material for the laboratory studies, chemist Jack Guggolz placed small amounts of straw or other high-fiber waste in copper or stainless steel tubes to facilitate control of temperature and pressure. Mr. Guggolz has treated more than 20 lignified waste materials.

The laboratory technique for measuring digestibility shows that alkali plus steam increases digestibility more than steam alone. For example, rice straw that was 34 percent digestible before treatment was upgraded to 43 percent digestibility with steam treatment and to 61 percent digestibility with steam plus sodium hydroxide. Comparable figures are 40, 49, and 76 percent for perennial ryegrass straw. For comparison purposes, the digestibility of good quality alfalfa hay usually is around 55 percent.

Feed value of treated and untreated material has been measured by a technique involving enzyme preparation to "digest" the feedstuff. In numerous experiments with other feedstuffs, results of this technique have correlated well with actual animal performance tests.

The ARS scientists stress, however, that animal feeding tests must be conducted to get a valid measure of digestibility. "Even if it should turn out, in the animal feeding trials, that treated wastes have the high levels of digestibility that are indicated by the enzyme method," Dr. Kohler says, "there will still be many questions for which no one now has answers. For example, there are obvious questions about cost, handling, marketing, and feeding. But first, we want to know how well animals digest the treated materials."

The ARS scientists recognize that some protein supplementation will be necessary to balance the carbohydrate derived from treated waste. ▪

A powerful and persistent synthetic lure for

Trapping the Gypsy Moth

ONE OF THE INSECT KINGDOM'S best kept secrets—the identity of the active ingredient in the gypsy moth's sex attractant—has been uncovered.

This discovery, the culmination of USDA studies begun in 1941, has made possible a synthetic lure for survey traps that is cheaper and more potent than extracts from female moths. Moreover, the lure may be utilized in new methods of controlling this destructive pest of northeastern forests that would minimize environmental pollution.

Cracking the chemical code involved a unique way to force extracts of the attractant to generate larger amounts of the active material than it normally contains. This indirect route to the source of the active material was discovered in analytical experiments at Beltsville, Md., by ARS chemists Morton Beroza and Barbara A. Bierl. The results led them to suspect that the active ingredient belonged to a certain group of epoxide compounds and that it was derived from an olefin in the insect extracts.

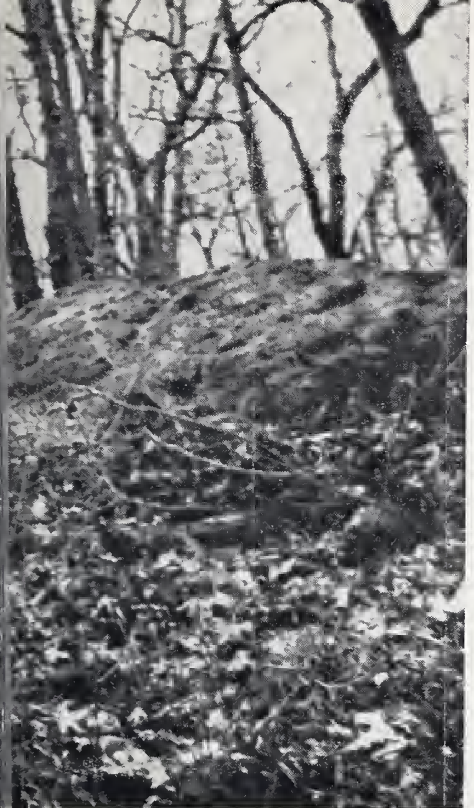
The chemists took an inactive fraction, or portion, of the extract containing the olefin and added *m*-chloroperbenzoic acid; the resulting chemical reaction generated larger quantities of the active material than is normally found in extracts.

The activated fraction produced striking results in laboratory and field tests conducted in infested areas of Cape Cod, Mass., by ARS plant protection specialists Carroll W. Collier, Joseph R. Tardif, Daniel A. Cook, F. M. Philips, and Edward M. Paszek. They found that traps baited with the activated fraction were remarkably persistent. The traps, set out in mid-April, had caught 240 male gypsy moths 3 months later, while traps baited with the crude extract attracted only 33 males. The amount of active material needed per trap was less than a microgram—too small an amount to be seen by the unaided eye.

This persistence and the even longer duration subsequently found in the synthetic lure, stand out in marked contrast to other lures, which persist for much shorter periods and thus necessitate more frequent rebaiting of survey traps.

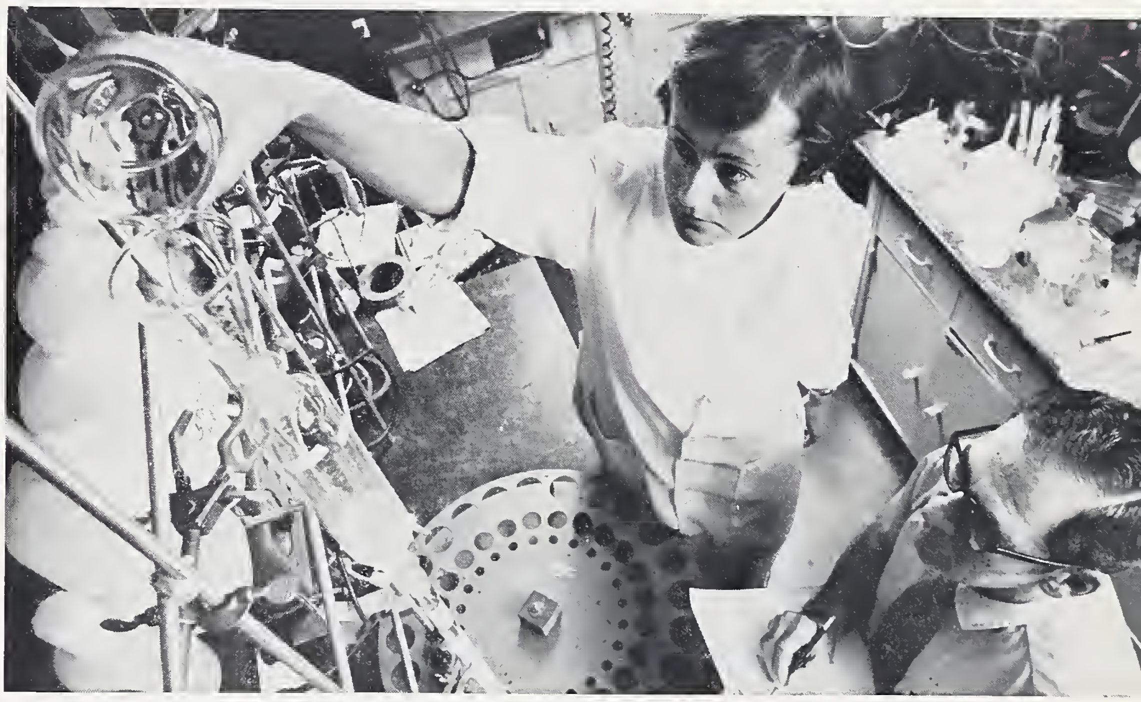
Encouraged by their preliminary findings, Dr. Beroza and Miss Bierl zeroed in on the previously inactive fraction, isolating the olefin precursor from other compounds in the fraction. They then identified the potent compound formed by chemical modification of the precursor as *cis*-7,8-epoxy-2-methyloctadecane—a compound indistinguishable from the female gypsy moth's sex lure, according to both laboratory analyses and responses by male moths.

Determining the chemical identity enabled the Beltsville scientists to synthesize an attractant, which they named "disparlure." Laboratory and field tests proved disparlure as effective as the female's natural attractant,



Far left: Dr. Beroza and Mr. Philips inspect a Cape Cod forest defoliated by the gypsy moth (0770C682–1). ***Left:*** *Tail section is clipped from female adult gypsy moth to make extracts of natural sex lure (0770C679–8).*

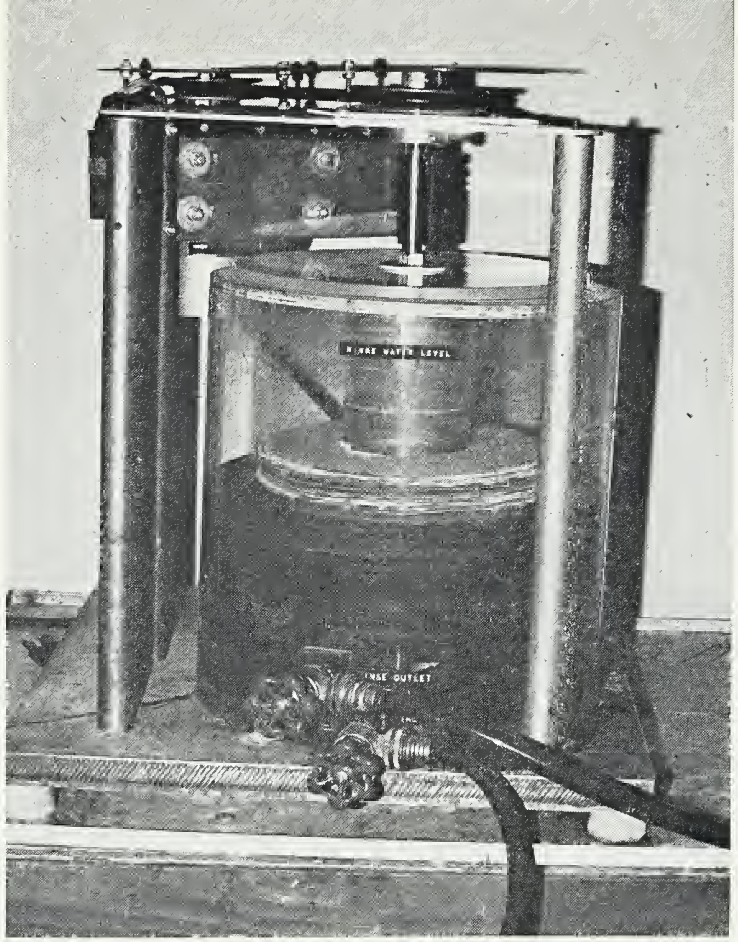
Below: *Dr. Beroza and Miss Bierl conduct chromatic separations of active sex lure material (0870C752–16).* ***Bottom left:*** *Dr. Cook prepares synthetic sex lure components to test response by male moths in holding device (0770C680–10).* ***Bottom right:*** *Technician rebaits trap in lightly infested area (0770C685–3).*



and many times more potent than the crude extracts used previously. For example, in one 10-day test, traps baited with the synthetic lure captured 110 male gypsy moths while traps with the crude extract captured three.

Other preliminary tests by control program officials were so promising that 33,000 traps containing the female extract were rebaited with disparlure in midseason. Gypsy moths were discovered in many areas thought free of the pests, thus providing an early warning for control officials.

Besides providing a more effective survey tool, disparlure may have potential for controlling the moth. The traps themselves might capture sufficient males to curb reproduction. Or, strategic distribution of the lure alone might possibly confuse males into a futile search for mates, culminating in death of the exhausted insects. Scientists may also explore the potential for applying insecticide only in limited areas baited with the lure. ▪



The unit egg processor with paper towels and plastic screens in place ready to be disinfected (PN–1910).

Device speeds insect-rearing project

STERILIZING INSECTS and releasing them into the native population is part of a continuing ARS program to develop safer and more effective pest control methods.

One of the big problems in mass rearing insects for sexual sterilization may now be solved, at least for the pink bollworm, with a device that disinfects the surface of insect eggs before incubation. Disinfection is necessary because disease and mold on the eggs can drastically affect hatchability. Hand methods of disinfection have been less than effective.

To get the eggs for mass rearing, scientists place adult insects in round cardboard containers with a screen at the top. A fiberglass screen, cut in an 8-inch diameter circle with a 4-inch circle cut out of the center, plus a paper towel cut out the same way, is placed on top of the carton. Two-inch diameter metal weights are placed around the paper surface to put pressure against the screens. The females lay their eggs on the weighted portion of the paper through the two screens.

After the eggs are laid, the paper rings with the egg masses attached are removed and—in the past—disinfected in a tray of a solution of formaldehyde. After that, the rings were placed in trays of running water where the formaldehyde was rinsed off. The rings were then spread out on tables and allowed to dry. The method was not only slow and labor-consuming, but chances for reinfection were great.

ARS agricultural engineer Paul E. James with the help of technician Hilding V. Anderson, both of Beltsville, Md., and entomologist Charles L. Mangum of Brownsville, Tex., may have changed most of the hand work by developing a unit egg processor.

It consists of a circular, plastic tank 12 inches high and 10 inches in diameter with a 4-inch diameter plastic spindle in the center.

After the eggs are laid, the paper and fiberglass rings are placed on the spindle and the spindle is set into the plastic tank.

Formaldehyde is poured into the cylinder and allowed to stand for 5 minutes. The cylinder is drained of formaldehyde and the spindle spin-dries the egg masses for about 2 minutes. The egg masses are rinsed for about 20 minutes with tap water, heated to 110° F. (higher temperatures harm the embryo). Next, they are drained and spun dry, thus readied for incubation. The device, among its other accomplishments, saves several dollars a day in formaldehyde that previously went down the drain in rinse water, and minimizes the diffusion of fumes in the work area. The warm water is part of the new process, replacing a previous method that called for putting the egg masses in an oven at 110° F. to evaporate any remaining formaldehyde solution.

Some 300 paper rings with egg masses attached can be put in the machine at one time. The circular fiberglass rings are used in the processor as spacers between paper rings.

The prototype model of the unit egg processor is now in use at the ARS Pink Bollworm Laboratory at Brownsville, with three more of the devices being built by the ARS Plant Protection Division in Beltsville. ■

Fungus promotes soybean yields

As a general rule when a fungus invades a plant, disease results. The fungus Endogone, however breaks the rules. Soybean yields in test plots were increased by as much as 40 percent by adding Endogone to fumigated soil.

Observations that well-nodulated soybeans sometimes do not grow well in fumigated soil suggested to ARS plant pathologist John P. Ross that fumigating might reduce or eliminate some beneficial organisms.

Dr. Ross tested his theory by adding about 4 ounces of soil from a high-yielding soybean field to each square foot of fumigated soil in small experimental plots. Other small plots received the same field soil, but sterilized. Soybeans were then planted and grown normally. Soybeans that had received unsterilized soil from the high-yielding field yielded about 50 percent more than the others.

When the roots of the soybean plants were examined microscopically, Endogone was growing throughout the roots of high-yielding plants but was absent in the others.

Spores of the fungus were isolated and then grown in the laboratory on soybean roots under sterile conditions to insure a good crop of pure fungus, free of other microorganisms.

The laboratory-grown fungus was then used the following year in fumigated soil in small, isolated plots and in field tests in fumigated and unfumigated plots at two locations in North Carolina. When Endogone was added in low amounts to the small plots, soybean yields increased by 34 percent—larger amounts increased the yield by 40 percent.

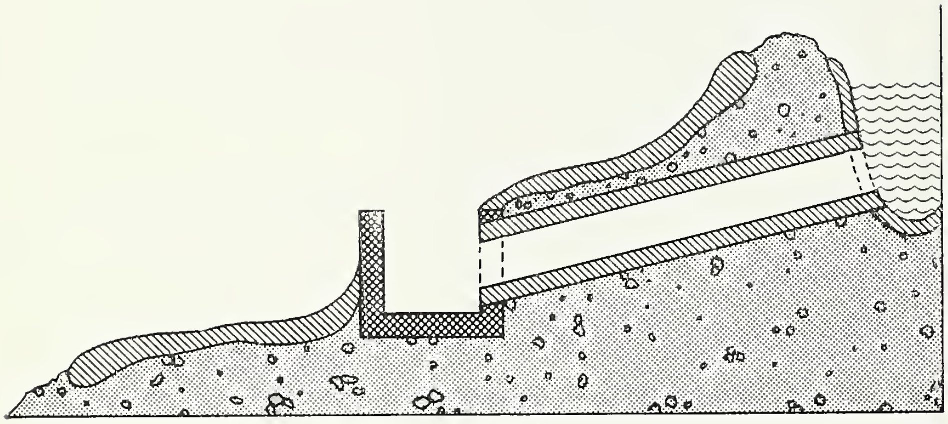
The number of flowers and size of plants grown with the aid of the fungus were noticeably greater than those grown without it. The foliage was a darker green and contained almost twice as much phosphorus and significantly more nitrogen, calcium, copper, and manganese as that of the uninfected plants.

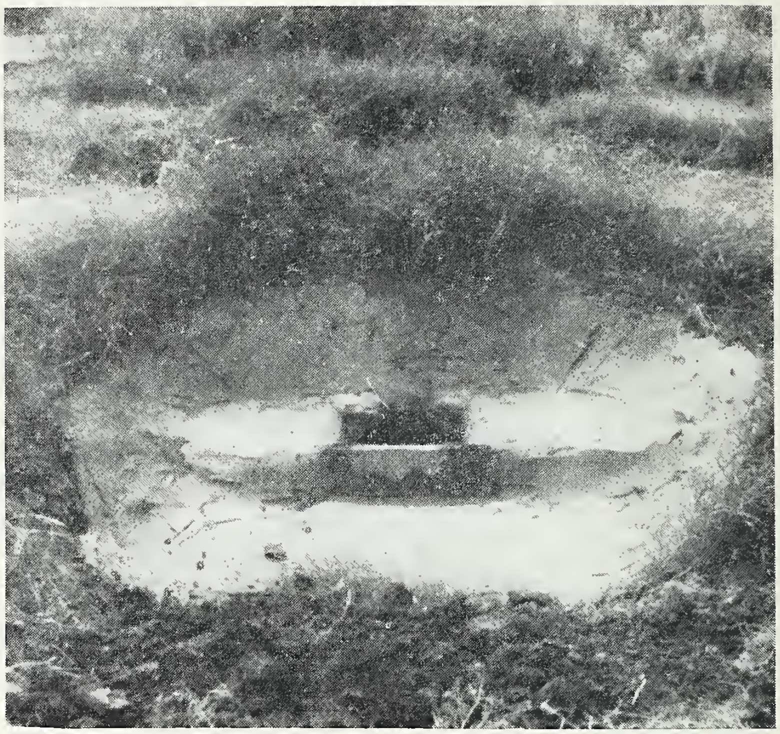
In the larger field trials, yields were increased by 29 percent in one location by adding the fungus and were not increased in others. Besides containing normal populations of Endogone, native field soils may contain other microorganisms that are antagonistic to or compete with Endogone, Dr. Ross believes.

Additional research is planned to find out more about the distribution and participation of the friendly fungus in soybean production. ▪

Technician John A. Harper takes soil samples from Endogone-free plot. Root fragments recovered from soil samples will be stained and observed for structures of the fungus (PN–1911).

Below: Cross-section of the turnout structure. Dissipator box is precast; the rest of the structure is formed on-site (PN–1925). *Right:* A recently completed structure (PN–1906).





for the Southwest

Irrigation turnout cuts erosion

FLOODING sandy southwestern soils puts a large quantity of irrigation water over a field in the required short time but causes destructive erosion at the field openings.

One remedy for the situation—a low-cost, nonerosive field turnout structure—has been developed by ARS at the U.S. Water Conservation Laboratory at Phoenix, Ariz. Making the study are agricultural engineer Leonard J. Erie, hydraulic engineer John A. Replogle, and technician Orrin F. French.

Much of the noncohesive soil in the Southwest is similar to Superstition sand in Arizona, which has a high-water intake rate and low-waterholding capacity and is easily eroded by wind and water. To irrigate such soil, large streams are necessary to get water to the other end of the field before it all soaks into the ground.

The Phoenix field turn-out structure dissipates some of the erosive energy of the water and causes more uniform spreading of the flow onto the field. The structure consists of a dissipator box, apron, shoulder, and back, all made of concrete. The dissipator boxes were at first cast in place, using wooden forms, but precasting the boxes off site and grouting them in place at the field sites proved easier and quicker.

The platform, shoulder, back, and apron are all free-formed at the site and, because little strength is required, no reinforcing is necessary. However, to assure a good seal between the box and the apron to control bermudagrass invasion, some wire screening, nails, or other metal strips can be left protruding from the top of the box to reinforce it with the apron.

After the engineers established suitable construction techniques, they noted failures due to only two causes—machinery damage and bermuda-grass invasion of small cracks which uplifted the edges of the shoulders and platform. Applying soil sterilants before constructing the structure would help cut down on the latter problem.

Shoulders of the structure are about 5 or 6 feet apart, higher than the anticipated high-water level, and protrude forward nearly perpendicular to the front edge of the dissipator box. They are also curved back about parallel to the bank. The back should also be higher than the anticipated high-flow level.

Machinery should not pass over the structures as it is probably not economically feasible to make them resistant to heavy equipment.

A poorly sized or improperly installed apron can wipe out all desirable characteristics of the outlet. The apron should be at least 3 inches below field elevation and level to evenly distribute 3- to 7- cubic feet per second flows in a fairly uniform fan. Aprons are easily broken and should protrude into the field no farther than necessary but should be at least 30 inches long in the direction perpendicular to the supply ditch.

After some construction experience with the structures, labor requirements should be about 2 man-hours or less per outlet. ▪

. . .Computers can solve the WIND-EROSION EQUATION

THE WIND-DROSION EQUATION—$E=f(I',K',C',L',V)$—a prescription for predicting soil loss from wind, has been programed for the computer.

Nearly 30 years of research determined relationships of the primary factors that cause soil erosion by wind (AGR. RES., Oct. 1961, p. 14) but manual solution is cumbersome because of the many tables and figures involved.

Users—mainly USDA's Soil Conservation Service—have emphasized the need to: Simplify the solution of the equation, especially the use of charts and scales; include alternative combinations of wind-erosion control practices; and note costs and degree of control.

That's why ARS soil scientist Edward L. Skidmore and agricultural engineer Neil P. Woodruff, both of the ARS Wind Erosion Laboratory and computer scientist Paul S. Fisher of the Kansas Agricultural Experiment Station, Manhattan, programed the equation for computer solution and simplified the equation's use.

Variables in the equation include erodibility (I'), roughness, (K'), climatic factor (C'), field length (L'), and vegetative cover (V). The general functional (f) relationship between the variables and soil loss (E) is solved stepwise by the computer to give potential average annual soil loss in tons per acre per year for specified conditions.

The computer can also solve the equation to determine field conditions necessary to reduce potential erosion to a tolerable amount and can compare the effectiveness of various combinations of erosion-control treatments.

Farmers can supply most of the information needed for the computer solution. For example, farmers can estimate ridge roughness and crop residue (K' and V) by comparing their fields with a series of photographs furnished them. For the climatic factor, including wind erosion forces, farmers can consult Agriculture Handbook 346, "Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss."

The rest of the information, except for dry sieving to determine the size of the soil aggregates, can be supplied on a special form by simply making observations and filling in the blanks. For length and mass measurements, either English or metric units can be used.

When the forms are filled in, the information is punched on cards and added to the source deck of the computer. The program is then ready to run to determine the annual potential soil loss for the conditions specified. As many sets of data as desired may be added to the deck and all run at the same time.

A second form is used to supplement the information on the first form to evaluate the various combinations of wind-erosion control practices such as increasing soil cloddiness, optimizing soil ridge roughness, increasing vegetative cover, establishing wind barriers, and decreasing field width.

"Speed," Dr. Skidmore says, "is probably the greatest advantage of the computer solution. High-speed, modern-day computers allow one to look at many combinations of wind-erosion control practices to select those most economical for particular field and climatic conditions." ▪

Dr. Skidmore (left) discusses field evaluation and the form to be filled out for the computer with agronomist Marvin Lundquist of the Sandyland Experiment Field in St. John, Kans. (PN–1913).

This "hive" was airdropped by parachute into bog. Airdropping by the freefall method proved better, however (PN–1908).

Airlifting bees

It may seem a bit ridiculous to airlift honey bees to work, but cranberry harvests may be bigger because of it.

Cranberry growers hire beekeepers to set up hives on the dikes surrounding cranberry bogs to aid pollinization of the blossoms. Along with being expensive, the method is not entirely successful. The bees seem to prefer the dike-bank flowers that contain nectar to cranberry flowers that don't.

One remedy would be placing hives via airdrops in the center of the bogs where bees could choose only the cranberry blossoms.

At the suggestion of ARS entomologists George E. Cantwell and Hachiro Shimanuki, agricultural engineer Henry J. Retzer, technician John N. Sauls, and airplane pilot Hilding V. Anderson, all of Beltsville, Md., rigged lightweight Styrofoam ice buckets and picnic chests into temporary "hives."

The hives were modified by cutting ventilation and escape holes and adding a piece of foundation comb and 4 ounces of granulated sugar. The wax comb is used by the bees as a starter comb, while the sugar is a temporary food supply until the insects start gathering their own.

The hives—with 1 pound or more of bees inside—were dropped on soft bogs near Chatsworth, N.J., at a speed of 80 miles per hour and altitudes of 200 and 300 feet. Some were dropped by parachute and others by free fall. Rip cords, attached to the plane, removed plastic tape over the escape holes as the hives were dropped.

Parachutes had a tendency to drag the hives across the bog, but near pinpoint accuracy without apparent injury to the bees was possible by the free fall drop.

Researchers will continue to study the method to see if the bees will in fact begin housekeeping in the middle of a cranberry bog and whether cranberry yields will be greater than in bogs pollinated the usual way. ■

Mini-chamber for seed germination

Plant breeders, plant physiologists, and other researchers who don't have or don't want to use large, expensive growth chambers for small-scale seed germination research may want to build their own—agronomist Willard C. Robocker did at Pullman, Wash.

There wasn't a regular growth chamber available for Dr. Robocker's seed germination studies, but there was space in a cold room. So he used 1-inch thick, rigid Styrofoam building insulation to make a shallow, lidded box about 16 inches square—large enough to hold 16 petri dishes. The ARS scientist placed a pair of 120-volt, 7½-watt bulbs painted black inside the box to provide the needed heat without light to affect light-sensitive seeds. Then he inserted a dial-type thermostat through one wall and connected it, along with the lights, to a timeclock to regulate temperature duration. A dial thermometer inserted next to the thermostat completed the germinator.

"My germination box, which can be easily built to almost any size, can be used in any room or refrigerator where a desired minimum temperature can be maintained," Dr. Robocker says, "and it's more versatile than commercial models for the special conditions we encounter in seed germination studies."

Commercially available chambers are expensive—$1,200 to $1,500 for a 2- by 4-foot chamber to $7.000 and up for a 4- by 8-foot one. And they are costly to operate, especially for small-scale work.

Dr. Robocker's chamber cost about $5, plus the price of the thermostat. ■

AGRISEARCH NOTES

Yeast That Permits Crossbreeding

Discovery of sexual reproduction in the yeast *Candida lipolytica* opens the way to breeding superior strains for protein production.

C. lipolytica cells grow in sugars, proteins, fats, or waxes and some petroleum products, and they can be harvested. Their potential for producing food or feed protein from petroleum products is under study by industry and university scientists.

Until now, this yeast had been classified as exclusively asexual, incapable of crossbreeding. Improving it was limited to selecting natural superior strains.

The sexually reproducing strain of *C. lipolytica* was discovered by microbiologists Lynferd J. Wickerham, Cletus P. Kurtzman, and Alberta I. Herman at the ARS Northern utilization research laboratory, Peoria, Ill. They also found that the strain is diploid. That is, each cell has twice as many chromosomes as are basic in this yeast.

Diploid cells usually are larger, grow faster, and offer more combinations of traits than cells having only one set of chromosomes, which are called haploid. Diploid cells might also be more easily harvested in industrial processes.

The Northern laboratory scientists found the yeast cells in material from a corn processing plant. They have grown the cells on paraffin-like hydrocarbons and have crossed some haploid strains. The industrial possibilities of this finding are great, and as yet unexplored.

Yeasts and other industrially important microorganisms are maintained in the ARS Culture Collection at the Northern laboratory and studied as a means of converting cereal grains to new products.

Dr. Hudson places seed collection bag over top of plant (PN–1917).

Vacuum Turned to Seed Collecting

A commercial insect collecting device has found a new use in the hands of researchers at Pullman, Wash. Horticulturist Lee W. Hudson of Washington State University and ARS agronomist Albert M. Davis say that the collector works exceptionally well for harvesting seed from most upright plants.

Formerly, seed for their studies was harvested by slipping a cloth bag over the seed heads, which were vigorously scrubbed together to dislodge the seeds. Immature seeds as well as fully ripened ones often came off the plants, seeds fell from the bag and were lost, and the scrubbing frequently damaged heads so that a subsequent harvest of the later-maturing seeds was impractical.

All of these problems are avoided with the insect collector. The machine, a sort of oversize vacuum cleaner, is carried papoose-like on the back of the operator. The device weighs about 40 pounds and is powered by a gasoline engine. The end of the vacuum hose, fitted with a cloth receiver bag at the suction end, is placed over the entire seed head, which is gently scrubbed by a helper. As each bag is filled, it is removed and replaced with a fresh one. The vacuum prevents seed from falling to the ground, the gentle scrubbing doesn't harm the seed head, and only the mature seeds are collected, leaving the immature seeds for later harvesting.

This collection technique is about twice as fast as the previous method and is much more efficient. However, the researchers are considering some modifications to further improve the system, such as eliminating bag changing and developing a better carrier for the rig—perhaps by mounting it on a garden tractor.

UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

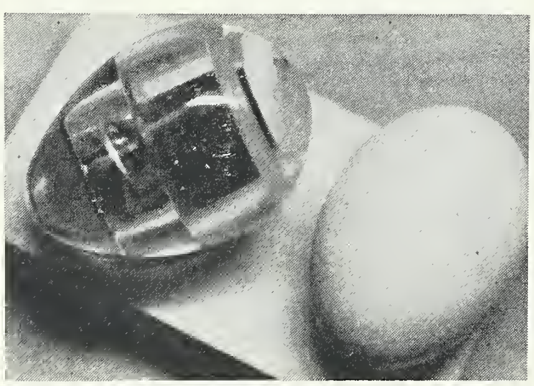
POSTAGE & FEES PAID
United States Department of Agriculture

AGRISEARCH NOTES

The Electronic Egg

An electronic "egg" has been developed that may help the egg-processing industry reduce breakage losses on high-speed mechanized grading and packing lines in commercial plants.

Each year about 5 percent of the total U.S. egg production is cracked or smashed. Of this, 4.5 percent are unsuitable for table use and 0.5 percent are completely lost. Combined, the two account for a reduction in value of the U.S. egg crop by an estimated $34 million annually.



Electronic egg and hen egg (PN–1918).

In cooperative research, ARS agricultural economist John A. Hamann, mechanical engineer William L. Shupe, electrical engineer Robert M. Lake, and engineering technician Edward W. Spangler, along with food technologist A. Wade Brant, California Extension Service, Davis, developed a means of pinpointing trouble spots in egg-processing equipment.

They designed a plastic egg, the same size and shape as a chicken egg, containing a very small and extremely sensitive device that converts mechanical energy and impact on the shell into electrical energy which is radioed to a remote oscilloscope receiver. Impacts show up on the receiver screen as sharp spikes and can be measured as to severity.

In laboratory studies, the maximum height from which a normal egg could be dropped onto a hard surface without cracking was measured. Then the spike that appeared on the screen when the test egg was treated the same way was measured and identified as the peak at or beyond which a normal egg would crack. When the test egg was run through a component of a mechanized grading system, the image of impact signals on the screen was identified and photographed, thus determining the breakage sites.

Now that their "egg" can locate trouble spots, the researchers visualize modification of mechanized egg handling equipment to reduce breakage losses.

Controlling Weeds in Lima Beans

Two herbicides usually are better than one for controlling weeds in lima beans. ARS plant physiologist Norman C. Glaze at Tifton, Ga., found that combinations of trifluralin and diphenamid generally provided more effective weed control than the same compounds applied singly. The predominant weeds in the test area were large crabgrass, Florida purslane, small-flower morning glory, sicklepod, and yellow nutsedge.

The best weed control was obtained with a mixture of 0.5 pound trifluralin and 2.0 pounds diphenamid per acre applied as a preplant incorporated treatment.

Neither chemical is registered by USDA for weed control in lima beans. For equivalent weed control in other crops for which each is registered, rates of the single herbicides must be higher than when they are combined. In tomato, diphenamid normally is applied at 4 lbs/a and in beans other than lima beans, trifluralin is used at 1 lb/a. This indicates another important plus for the system. Based on Dr. Glaze's studies, it appears that crop and soil herbicide residues may be reduced where chemical combinations are used because the rates of each component are usually lower than when either compound is used alone.

Other herbicide combinations that provided good weed control in the experiments without adversely affecting lima bean yield included trifluralin plus dinoseb or linuron, chlorpropham with methyl ester of cloramben, and linuron or DCPA and diphenamid plus dinoseb.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

PROTECT
Use Pesticides Safely
FOLLOW THE LABEL

U.S. GOVERNMENT PRINTING OFFICE: 1970